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Revision 2
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System Design Criteria for the OU 7-10 Glovebox Excavator Method Project

Instrumentation and Control Design Criteria

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Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

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Idaho National Engineering and Environmental Laboratory
Environmental Restoration Program
Idaho Falls, Idaho 83415

Prepared for the
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Assistant Secretary for Environmental Management
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Approved by

Tom Hipp

Thomas M. Hipp, Bechtel BWXT Idaho, LLC
OU 7-10 Glovebox Excavator Method Project
Instrumentation and Control Design Lead

10/2/02
Date

Brent R. Helm

Brent R. Helm, Bechtel BWXT Idaho, LLC
OU 7-10 Glovebox Excavator Method Project
Design Lead

10/3/02
Date

Steven A. Davies

Steven A. Davies, Bechtel BWXT Idaho, LLC
OU 7-10 Glovebox Excavator Method Project
Project Engineer

10/08/02
Date

CONTENTS

ACRONYMS

ALARA	as low as reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
CAM	continuous air monitor
CAS	criticality alarm system
CCTV	closed-circuit television
D&D&D	deactivation, decontamination, and decommissioning
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
FGE	fissile gram equivalent
HEPA	high efficiency particulate air
I&C	instrumentation and control
INEEL	Idaho National Engineering and Environmental Laboratory
NFPA	National Fire Protection Association
OU	operable unit
PCM	personnel contamination monitor
PDSA	preliminary documented safety analysis
PLC	programmable logic controller
RAM	radiation area monitor
RCS	Retrieval Confinement Structure
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SDC	system design criteria
SSC	system, structure, or component
TFR	technical and functional requirements

UPS	uninterruptible power supply
WAG	Waste Area Group
WES	Weather Enclosure Structure

System Design Criteria for the OU 7-10 Glovebox Excavator Method Project

Instrumentation and Control Design Criteria

1. INTRODUCTION

This Operable Unit (OU) 7-10 system design criteria (SDC) document establishes the instrumentation and control (I&C) design criteria for the OU 7-10 Glovebox Excavator Method Project. It is intended to augment the parent document (i.e., *OU 7-10 Glovebox Excavator Method Project Technical and Functional Requirements* [INEEL 2002a]) sufficiently to enable performance of the project detailed design, engineering, and evaluation activities.

The *Record of Decision: Declaration of Pit 9 at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory, Idaho Falls, Idaho* (DOE-ID 1993) specifies the environmental remediation of transuranic (TRU) waste from OU 7-10 (which comprises Pit 9) of Waste Area Group (WAG) 7. On October 1, 2001, the Idaho National Engineering and Environmental Laboratory (INEEL) published the *WAG 7 Analysis of OU 7-10 Stage II Modifications Report* (INEEL 2001), which identified a feasible approach for retrieving waste from OU 7-10. The OU 7-10 Glovebox Excavator Method Project was established to accomplish the objectives presented in that report. The overall objectives for the project are as follows:

- Demonstrate waste zone material retrieval
- Provide information on any contaminants of concern present in the underburden
- Characterize waste zone material for safe and compliant storage
- Package and store waste onsite, pending decision on final disposition.

This project is requested by the U.S. Department of Energy Idaho Operations Office (DOE-ID) in support of the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (FFA/CO) (DOE-ID 1991), OU 7-10 Record of Decision (DOE-ID 1993), *Explanation of Significant Differences for the Pit 9 Interim Action Record of Decision at the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1998), and Appendix A of the *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit OU 7-10 (Pit 9 Project Interim Action)* (LMITCO 1997).

1.1 Facility Description

The INEEL is a U.S. Department of Energy (DOE) facility, located 52 km (32 mi) west of Idaho Falls, Idaho, and occupies 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Idaho Snake River Plain. The Radioactive Waste Management Complex (RWMC) is located in the southwestern portion of the INEEL. The Subsurface Disposal Area (SDA) is a 39-ha (97-acre) area located in the RWMC. Waste Area Group 7 is the designation recognized by Comprehensive Environmental Response, Compensation and Liability Act (42 USC § 9601 et seq.) and in the Federal Facility Agreement and

Consent Order (DOE-ID 1991) for the RWMC, which comprises the SDA buried waste site. Waste Area Group 7 has been divided into 13 OUs[a]. Operable Unit 7-10 is located in the northeast corner of the SDA. The OU 7-10 site is an area into which chemicals, radioactive materials, and sludge from DOE weapons plants and other government programs were disposed of. While such disposal at the RWMC began in 1952, OU 7-10 was used and filled in the late 1960s. The pit contains characteristic hazardous, listed hazardous, low-level radioactive, and transuranic waste.

The project facilities and processes are being designed to safely conduct a waste zone material retrieval demonstration in a selected area of OU 7-10. The project processes consist of excavation and retrieval; sampling, packaging, and interim storage; shutdown; deactivation, decontamination, and decommissioning (D&D&D); and environmental monitoring. Project facilities include a Weather Enclosure Structure (WES), Retrieval Confinement Structure (RCS), excavator, ventilation system, and other supporting equipment. The packaged material will be stored onsite, pending decision on final disposal.

1.2 Limitations of the System Design Criteria

This SDC document defines the criteria for the I&C aspects of the project. The SDC flow directly from the Technical and Functional Requirements (TFR) document (INEEL 2002a) and are intended to include detail not provided in the TFRs, client requirements, and those codes, standards, and regulations that will be used as a basis for the design of the I&C systems. Design criteria will be revised, as needed, as the project proceeds.

This SDC document focuses only on the I&C design criteria. The SDC for general structures and site; process, excavation, packaging, and fire protection; and facilities and infrastructure are addressed in separate documents.

1.3 Ownership of the System Design Criteria

This SDC document is the product of the combined activities of the project team. The project engineer has the ultimate responsibility for the content and approval of this document.

a. Operable Units 13 and 14 were combined in the 1995 comprehensive remedial investigation and feasibility (Huntley and Burns 1995).

2. OVERVIEW

2.1 Facility Structure, System, and Component Functions

The project I&C system ensures worker safety, environmental protection, and process effectiveness. In order to perform these functions, four subsystems have been identified:

- Facility monitoring and control
- Radiological, criticality, and emissions monitoring
- Fissile material and final drum assay monitoring
- Closed-circuit television (CCTV) monitoring
- Each of the four subsystems is described in greater detail in Sections 2.3.1 through 2.3.4.

2.2 Facility Structure, System, and Component Classification

No safety-class structures, systems, or components (SSCs) are associated with this project.

The *Preliminary Documented Safety Analysis for the Operable Unit 7-10 Glovebox Excavator Method* (INEEL 2002b) provides a description of the facility safety basis and identifies its safety-significant design features. It prescribes minimum design criteria and functional requirements for the project to follow. The criticality alarm system (CAS) and the Glovebox Fissile Material Monitoring System sample bucket are the only components of the I&C system that are considered safety significant. Appendix A discusses the critical attributes of these items.

2.3 Operational Overview

This project includes systems supporting the retrieval and packaging of waste zone material. The site where the facilities will be located has 6-in. diameter probes that were installed to refusal during Stage I of the OU 7-10 Staged Interim Action Project. These probes may be moved during waste zone material retrieval to facilitate retrieval operations. Overburden will be excavated and packaged before disturbing waste zone material.

A manned excavator will retrieve waste zone material. The operator will be located in the WES outside the RCS. The excavator arm, contained within the RCS, will excavate an angular swath. The retrieved material in the excavator bucket will then be placed into a transfer cart. One transfer cart is located at the entrance of each of the three material packaging gloveboxes. The carts transport waste zone material into the gloveboxes, where it will be inspected, sampled, and packaged. Packaged waste will then be assayed to determine total fissile mass. The waste will then be stored onsite, pending decision on final disposition.

After waste zone material excavation is complete and samples of the underburden are taken, the pit will be backfilled for closure prior to D&D&D.

An I&C system will be designed and installed for safe and effective operations to support the activities described above. Operational overview for the four instrumentation and control subsystems are discussed in the following sections.

2.3.1 Facility Monitoring and Control

A programmable logic controller (PLC) is used for overall facility monitoring and control. The PLC monitors operating conditions such as pressure differences across confinement barriers and ventilation system flow. The PLC also receives inputs from hazard monitoring equipment and automatically generates predetermined outputs to ensure protection of public, workers, and the environment.

2.3.2 Radiological, Emission, and Criticality Monitoring

Based on knowledge of the nature of the waste zone material being removed in the project, radiological monitoring equipment is essential to worker safety and environmental protection. The three radiological monitoring subsystems are:

- Radiological monitoring for personnel safety within the WES
- Emissions monitoring for environmental safety
- Criticality monitoring for personnel safety in the project operations area.

2.3.2.1 Radiological Monitoring. The project design team has made an extensive effort in SSC design to protect operators from process hazards, but potential radiation hazards still exist. For example, while historical records of the waste zone material indicate the material can be handled by personnel at the gloveboxes, there is still a potential to encounter a higher than expected gamma radiation source. Should this happen, radiation area monitors (RAMs) located near operator stations would notify operators to keep exposure within acceptable limits. Once a predetermined exposure rate has been exceeded, the RAM will alarm, and the operator will leave the area. Support radiological personnel will determine on a case-by-case basis how to resolve these abnormal events.

The design team has invested significant effort in confinement area design to ensure containment. However, the potential risk of contamination escape from the confinement SSCs still exists. Should a release of radioactive contamination into the operator areas of the WES occur, continuous air monitors (CAMs) will detect the airborne radioactive particles and alarm. Procedures require operators to evacuate to a predetermined safe area. Again, support radiological control technicians will determine how to most effectively resolve this unlikely abnormal event.

In addition to the possibility of airborne contamination, contamination may be present on an operator's skin, clothing, or shoes. Personnel contamination monitors (PCMs) are available and can conduct a complete exterior body survey in less than a few minutes. In addition, hand-held friskers are located at key locations, such as gloveboxes. Operators are required to frisk their hands when they remove them from the gloves to verify that no contamination has passed through the gloves onto the operator's hands.

With the RAMs, CAMs, PCMs, friskers, and supporting equipment, a complete system is in place to ensure operators are protected from radiological hazards and any contamination is detected and quickly contained.

2.3.2.2 Emissions Monitoring. Environmental protection includes high-efficiency particulate air (HEPA) filters on the ventilation exhaust from the excavation facility. While a system has been incorporated into the RCS design to control dust, contamination will inevitably be drawn into the ventilation stream. Particles in the ventilation exhaust will be removed by the HEPA filters.

To quickly detect any excess radioactive WES ventilation system emissions, an emissions monitoring system detects levels of contaminants in the emissions above threshold limits. If a high level of emissions is detected, all operations will cease and appropriate actions will be taken. Support radiological personnel will then take appropriate actions.

2.3.2.3 Criticality Monitoring. Although a criticality in the RCS and PGS is extremely unlikely, it is not incredible. Therefore, a CAS is deemed to be necessary and designed to detect any postulated criticality within the retrieval structure.

The detector enclosure houses three detectors. A CAS must detect the criticality, but it must also avoid false alarms. The three detectors in this system feed a voting module. These detectors are sensitive to neutrons, but are relatively insensitive to gamma radiation.

Using three detectors, the voting module design provides redundancy. The system remains functional if one detector fails, and even if the detector failure mode supplies a high output signal, a false alarm will not occur. Therefore, the three-detector voting module design minimizes false alarms.

The CAS control has a visual and audible failure warning to alert personnel to possible CAS malfunctions and avoid the dangers of a faulty CAS. The CAS control logs all criticality events, including time, date, and duration.

2.3.3 Fissile Material and Drum Assay Monitoring

Operable Unit 7-10-area historical waste records indicate the presence of fissile material. The primary element of concern is plutonium. To ensure initial compliance with the waste acceptance criteria, fissile material content has been restricted in 55-gal drums to less than 200 g.

The I&C design incorporates a fissile material monitor into the glovebox design and operations. Glovebox operators place materials such as HEPA filters, HEPA filter media, and nonidentifiable combustible materials that are indistinguishable from HEPA filter media into the fissile material monitor sample container. The detector measures the gamma spectrum of the isotopes contributing to the fissile material inventory. A gamma spectrum count of the well specimen is made and displayed along with a running total of what has been loaded into the drum. A local fissile material monitor touch screen warns the operator to avoid exceeding the 200-g fissile material limit for a single drum.

After operators have filled and sealed a waste drum, a forklift operator transfers the drum to a drum assay trailer. The assay system will be capable of assaying 55- and 85-gal drums. Instruments in the drum assay trailer determine the fissile material content of the drum. This assay is necessary to ensure that the drum meets the storage criteria of the interim storage.

2.3.4 Closed-Circuit Television Monitoring

Closed-circuit television monitoring is essential to RCS operations. The RCS cameras give the excavator operator a clear view of the dig area. During excavation, the operator's view is restricted as a result of RCS structures, the boom or stick, and the pit blind spots. Further, due to the distance from the operator's eyes to the actual dig location, the operator lacks the fine visual resolution necessary to effectively conduct waste handling in potentially tight locations and difficult situations, making the cameras a necessity. The operator can select, aim, and focus the camera with the best view on the area of interest and the remote control allows the operator to multiply the optical image by a factor of 18 to 1. With the cameras in the RCS and a CCTV screen in the excavator cab, the operator can optically move in close to examine the waste material of interest. These images also are available at the CCTV console in the WES for support personnel to view.

Additionally, CCTV monitoring is present at the PGS gloveboxes to video record glovebox operations. The video recording supports the needs of INEEL Safeguards and Security organization. The video recordings will be periodically reviewed by security personnel to ensure any potentially classified material was handled appropriately.

3. DESIGN CRITERIA AND BASES

This section provides criteria for the design of the instrumentation, controls, and monitoring systems for this project. The monitoring and control system will provide the necessary controls to ensure the safe effective operation of the glovebox excavator method process. This control will be integrated into the excavation, glovebox, ventilation, and support operations. The I&C system will provide the radiological monitoring, WES exhaust monitoring, and CAS to support the project. The I&C system will provide two systems for determining the fissile material content of the waste. One will monitor possible HEPA filter material during operations in the glovebox, while the other will assay entire drums before they are stored. Finally, the I&C system will provide a CCTV system which will provide video monitoring to assist the excavator operator when removing materials from the pit. In addition, the video system will provide a recording of the dig operation.

3.1 General Instrumentation and Control

This section identifies the design criteria for the overall I&C system. Design criteria specific to the CCTV system; monitoring and control; radiological control, criticality, and emissions monitoring; and fissile monitoring systems are located in the sections that follow.

3.1.1 Operational Design Criteria

The following operational design criteria apply to the entire I&C system. Operational design criteria for specific I&C subsystems are addressed in Sections 3.2 through 3.5.

1. The I&C subsystems shall be capable of operating within the expected temperature range of the WES.

   Basis: The WES is expected to have a potentially wide temperature operating range and some I&C equipment may be sensitive to these temperature extremes. The design must account for this possible operating environment. Presently, the anticipated temperature range is 50 to 95°F. Temperatures in the facility must not fall below a point at which the equipment will operate. All equipment will operate satisfactorily if the comfort zone temperatures required by Section 1550 of the DOE-ID "Architectural Engineering Standards" are met. TFR Section 3.2.6-4.

2. The I&C system shall, to the extent possible, consist of commercially available, off-the-shelf components.

   Basis: These items are readily available, and have shorter delivery times, known reliabilities, and lower cost. TFR Section 3.1.3-1.

3. The instrumentation and control system materials to be exposed to the radioactive and hazardous waste expected to be encountered during operations shall be compatible with such waste.

   Basis: To ensure reliability of the instrumentation and control system. Reactions with hazardous or radioactive waste materials may cause corrosion and general deterioration. Information regarding compatibility with the radioactive and hazardous waste can be located in EDF-2041 and EDF-ER-211.

3.1.2 Accident Design Criteria

The following accident design criteria apply to the entire I&C system. Accident design criteria for specific I&C subsystems are addressed in Sections 3.2 through 3.5.

1. The instruments and controls must meet the design criteria for Performance Category. See the *System Design Criteria for the Operable Unit 7-10 Glovebox Excavator Method Project – General Structures and Site Design Criteria* (INEEL 2002c) for specific criteria.

   Basis: The I&C equipment must support overall design and operations during a postulated seismic event. The instrumentation and controls must meet the design criteria for seismic events when failure of the instrumentation and control support could impact safety-significant and low safety consequence systems. TFR Section 3.2.5-1.

2. The I&C equipment shall be provided with backup power where the loss of power would cause the loss of monitoring and control functions.

   Basis: To prevent data and control loss in the event of a loss of commercial power.

3. An uninterruptible power supply (UPS) shall provide backup power to the PLC, 24 Vdc instrumentation, supervisory control and data acquisition system, and the fissile material monitor detector coolers.

   Basis: To prevent data loss and loss of operating time and efficiency in the event of a loss of commercial power. The UPS must provide backup power until the backup generator is on-line.

4. The UPS shall provide 120 Vac for a minimum of 15 minutes.

   Basis: To prevent data and control loss and loss of operating time and efficiency in the event of a loss of commercial power. The UPS must provide backup power until the backup generator is on-line.

3.1.3 Safety-Significant Items

Items designated as safety significant are identified under the specific applicable subsystem in the subsections that follow.

3.1.4 Applicable Regulatory and Contractual Requirements

The following laws, regulations, or contractual requirements are applicable to all instrumentation and control systems in addition to those that are listed specifically within the subsections:

- 29 CFR 1910, "Occupational Safety and Health Regulations" (2002)
- 29 CFR 1926, "Safety and Health Regulations for Construction" (2002)
- DOE Order 420.1, "Facility Safety" (November 2000)
- DOE-ID "Architectural Engineering Standards" (2001).

3.1.5 Applicable Industry Codes and Standards

The following industry codes and standards are applicable to all instrumentation and control systems in addition to those that are listed specifically within the subsections.

National Fire Protection Association (NFPA) 70, "National Electric Code" (1999).

3.2 Facility Monitoring and Control Systems

This section contains the design criteria for the facility monitoring and control systems.

3.2.1 Operational Design Criteria

The following operational design criteria are specific to the various components of the monitoring and control systems:

1. All equipment associated with the monitoring and control system shall be installed to maintain confinement of radioactive materials.

   Basis: The primary purpose of the monitoring and control system is to ensure safety for the public, workers, and the environment, as mandated by DOE Order 420.1, "Facility Safety." As such, containment of radioactive materials must be maintained. TFR Sections 3.1.1.1-2, 3.1.1.1-5, 3.2.7-1, and 3.2.7-2.

2. All equipment associated with the monitoring and control system shall be installed to permit access for maintenance.

   Basis: Accessibility to the equipment enables routine maintenance to ensure reliability of equipment. Entry into the RCS is allowed only for nonroutine maintenance. Entry into the packaging gloveboxes is assumed to not be possible. TFR Section 3.3.1-2 and 3.4.4-1.

3. The monitoring and control system shall monitor operating conditions (e.g., HVAC, filter delta pressure, confinement zone pressures). Note: I&C will maintain an input and output list that shows all systems monitored and controlled.

   Basis: The primary purpose of the monitoring and control system is to ensure safety for the public, workers, and the environment, as mandated by DOE Order 420.1, "Facility Safety." TFR Sections 3.1.1.1-5, 3.1.1.2-3, 3.2.7-1, and 3.2.7-2.

4. The monitoring and control system shall be based on an Allen-Bradley ControlLogix system.

   Basis: The INEEL engineers and technicians have extensive experience in the design, installations, and programming of this equipment. This equipment and associated software has proven to be effective. Additionally, the project is required to use commercially available equipment and products, where available. TFR Section 3.1.3-1.

5. The monitoring and control system PLC chassis shall be large enough to provide for 20% input and output growth.

   Basis: To accommodate possible future additional control functions by the PLC.

6. The monitoring and control system PLC shall be powered by 120 Vac, 60-Hz electrical power.

   Basis: To use readily available electrical power in the WES. The design must use existing utilities, where available. The intent of using existing utilities is to be cost effective by minimizing new construction, recognizing that additional utility services may be required if the processes or equipment are used for follow-on implementation at a later date. TFR Section 3.1.3-3.

7. The monitoring and control system PLC digital inputs and outputs shall, to the extent possible, be 24 Vdc.

   Basis: To ensure safe operation and maintenance of the control system.

8. The monitoring and control system shall, to the extent possible, have finger safe terminals.

   Basis: To ensure safe maintenance of the control system.

9. The monitoring and control system uninterruptible power supply (UPS) battery shall be sized to provide the necessary electrical power for at least 15 minutes to all of the instrumentation loops.

   Basis: To ensure all monitoring and control during electrical power outages.

10. Each terminal block shall have neon-blown fuse indicators.

    Basis: To ensure timely maintenance of control systems.

11. The monitoring and control system shall incorporate event detection and tracking system information at runtime using activity logging, alarm logging, and data logging.

    Basis: To support safe operation and maintenance. TFR Section 3.3.6-1.

3.2.2 Accident Design Criteria

The following accident design criteria are specific for the various components of the monitoring and control system:

1. The monitoring and control system equipment shall alarm locally to alert operators of abnormal conditions.

   Basis: Both audible and visual alarms will be provided to ensure worker safety. Local alarms are mandated by 10 CFR 835, "Occupational Radiation Protection," and DOE Order 420.1, "Facility Safety." Supports as low as reasonably achievable (ALARA) goals. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, and 3.2.4-1.

2. In the event of an accident, failure, or upset conditions, the monitoring and control system shall take predetermined corrective action. Unacceptable operating conditions shall be reported via the INEEL paging system to predetermined supervisory and support personnel outside the WES.

   Basis: To ensure protection of the public, workers, and the environment. Mandated by DOE Order 420.1, "Facility Safety." Supports ALARA. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, 3.2.7-1, and 3.2.7-2.

3. In the event of a monitoring and control system failure, operators shall be notified of the failure.

Basis: To prevent operations without the safety features of the monitoring and control system.

3.2.3 Safety-Significant Items

No safety-significant items have been identified for the monitoring and control system.

3.2.4 Applicable Regulatory and Contractual Requirements

No specific regulatory or contractual requirements other than those listed in Section 3.1.4 apply to the monitoring and control system.

3.2.5 Applicable Industry Codes and Standards

The following applicable industry codes and standards are specific to the monitoring and control system:

NFPA 79, "Electrical Standard for Industrial Machinery" (1997).

3.3 Radiological, Criticality, and Emissions Monitoring Systems

This section contains the design criteria for the OU 7-10 Glovebox Excavator Method radiological control and emissions monitoring and CASs.

3.3.1 Operational Design Criteria

The following operational design criteria are specific to the various components of the radiological control and emissions monitoring and criticality alarms systems:

3.3.1.1 Radiological Control. The following design criteria are specific to the radiological control monitoring system:

1. The radiological control monitoring system shall consist of CAMs, RAMs, PCMs, hand monitors, frisking stations, smear counters, dosimetry (electronic and thermoluminescent dosimeters), radiological computer database, and portable instrumentation.

   Basis: As directed by 10 CFR 835 and the INEEL Radiological Controls Manual. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, 3.2.7-3, 3.3.5-1, and 3.3.5-2.

2. The radiological control monitoring system shall use CAMs for personnel protection from potential airborne radioactivity.

   Basis: 10 CFR 835.403 and INEEL Manual 15A, Radiation Protection INEEL Radiological Control. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, 3.2.7-3, 3.3.5-1, and 3.3.5-2.

3. The CAMs shall be equipped with flexible power cords.

   Basis: The final location of the CAMs shall be determined by airflow testing. Flexible cords allow flexibility of location for the CAMs.

4. The CAMs shall consist of both alpha and beta-gamma units.

   Basis: The final quantities and locations of these CAMs are to be evaluated by Radiological Engineering and documented in an engineering design file. Both alpha and beta-gamma CAMs are considered necessary by Radiological Engineering. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, 3.2.7-3, 3.3.5-1, and 3.3.5-2.

5. CAMs shall be selected for the particular airborne contamination of concern.

   Basis: Contamination of concern will most likely be Pu-242, Pu-239 and Am-241. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, 3.2.7-3, 3.3.5-1, and 3.3.5-2.

6. RAMs shall be used to inform operators of unanticipated increases in levels of radiation.

   Basis: 10 CFR 835.402.a. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, 3.2.7-3, 3.3.5-1, and 3.3.5-2.

7. PCMs shall be used for complete external contamination monitoring.

   Basis: 10 CFR 835.1102. TFR Sections 3.2.2-1, 3.2.2-2, 3.2.2-3, and 3.2.7-3.

3.3.1.2 Criticality Alarms

The following design criteria are specific to the OU 7-10 Glovebox Excavator Method Project CAS:

1. A CAS shall be installed that is relatively sensitive to neutrons and relatively insensitive to gamma radiation.

   Basis: Neutron detection is preferred to gamma detection since uncertain levels of gamma radiation may be encountered. TFR Sections 3.2.3-1 and 3.2.3-4.

3.3.1.3 Weather Enclosure Structure Exhaust Monitoring System. The following operational design criteria are specific to the exhaust monitoring system:

Note: The following criteria do not apply to the exhaust of the excavator.

1. The exhaust monitoring system shall monitor particulate emissions.

   Basis: 40 CFR 61.93.b.4.i.(4).(i) The dose from Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, and Am-241 in accordance with *Operable Unit 7-10 (Pit 9) Interim Action Project Stage II Air Emissions Evaluation* (Abbott 2000), exceeds 1% of 100 mrem/year. TFR Section 3.3.5-2.

2. The exhaust monitoring system shall provide a representative sample over the operational range of the exhaust system (i.e., flow rates and temperature).

   Basis: 40 CFR 61.93.b.1.iii. TFR Section 3.3.5-2.

3. The exhaust monitoring system shall include equipment to provide real-time monitoring of alpha particle levels in the exhaust emissions. The alpha monitor shall be an Eberline Alpha-7 or approved equal.

Basis: Per radiological engineering, best management practice. To mitigate any releases, an active near real time monitoring system will provide a signal to operations personnel to indicate excessive releases. The active near-real-time monitor system must be able to monitor Pu-239 and Am-241. Some releases can have varying ratios of these two key isotopes simultaneously. The Eberline Alpha-7 is the only commercial-off-the-shelf system continuous air monitor that has this capability. This will prevent a potential excessive release as stated in 40 CFR 61.94.c. TFR Section 3.3.5-2.

4. The exhaust monitoring system alpha monitor shall be calibrated to detect and alarm on at least Pu-239 and Am-241.

   Basis: Per radiological engineering, best management practice. Pu-239 and Am-241 are estimated to contribute over 90% of the potential dose to the maximum exposed individual (EDF-ER-WAG7-109, January 2000 [Abbott 2000]). TFR Section 3.3.5-2.

5. The exhaust monitoring system shall collect representative samples via shrouded probes, in accordance with American National Standards Institute (ANSI)/HPS N13.1-1999, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*.

   Basis: OU 7-10 management has decided to use ANSI/HPS N13.1-1999, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*. TFR Section 3.3.5-2.

6. Samples shall be taken from a portion of the exhaust that provides adequate mixing.

   Basis: ANSI/HPS N13.1-1999 performance-based standard. TFR Section 3.3.5-2.

7. The exhaust monitoring system instrumentation shall be located in a climate-controlled enclosure (internal temperature of between 60 and 90°F).

   Basis: Instrumentation inside the cabinet is temperature limited. TFR Section 3.3.5-2.

8. Space for expansion for additional monitoring equipment also shall be considered.

   Basis: Allows flexibility in the design, in accordance with project management direction.

9. The exhaust monitoring system shall monitor and log the following alarms:

   - Low exhaust flow
   - Low sample flow
   - Radiation alarms.

   Basis: To provide notification and indication of stack monitoring parameters outside the acceptable parameters for operations.

10. The exhaust monitoring system shall monitor and log the following analog measurements:

    - Exhaust temperature
    - Exhaust flow

- Sample flow for each sample line
- Alpha monitor readings.

Basis: To determine releases as required in 40 CFR 61, Subpart H, "National Emissions of Radionuclides other than Radon from Department of Energy Facilities," requirements.

3.3.2 Accident Design Criteria

The following accident design criteria are specific to the various components of the radiological control and emissions monitoring and criticality alarms systems:

3.3.2.1 Radiological Control. The following accident design criteria are specific to the radiological control monitoring system:

1. No radiological control monitoring system equipment shall be required to operate during a power outage.

   Basis: During a utility power loss, all personnel will evacuate the WES; therefore, the radiological monitoring system equipment does not need to be operational during power outages.

2. The radiological control monitoring system shall be determined operable after power outages or seismic events prior to resumption of normal WES operations.

   Basis: To ensure operator safety upon resumption of operations following return of commercial power or after a design basis seismic event.

3.3.2.2 Criticality Alarms. The following accident design criteria are specific to the OU 7-10 Glovebox Excavator Method Project CAS:

1. Upon detection of a criticality, the CAS shall alarm personnel within a predetermined 12-rad boundary.

   Basis: ANSI/American Nuclear Society (ANS) -8.3-1997, *Criticality Accident Alarm System*. TFR Section 3.2.3-4.

2. No criticality alarm equipment shall be required to operate during a power outage or seismic event; however, the CAS shall be provided with an internal battery backup to be sufficient until standby power becomes available.

   Basis: During a utility power loss or earthquake, all personnel will evacuate the WES per the Preliminary Documented Safety Analysis (PDSA) (INEEL 2002b); therefore, the system does not need to be operational during a loss of commercial power. By taking this administrative approach, the WES and supporting battery backup do not need to be classified as safety significant, which avoids unnecessary design, construction, and maintenance costs.

3. The CAS shall be determined operable after power outages or seismic events prior to resumption of normal WES operations.

Basis: To ensure operator safety upon resumption of operations following return of commercial power or after a design basis seismic event. TFR Section 3.2.3-4.

3.3.2.3 Exhaust Monitoring System. The following accident design criteria are specific to the exhaust monitoring system:

1. In the event of loss of operability of the exhaust monitoring system, operators shall be notified of the failure via an audible and visual alarm.

   Basis: If the monitoring system fails, then the release is not being continuously monitored as required in 40 CFR 61.93.b.2.ii. Audible and visual alarms provide prompt notification to ensure operability of the monitoring system. TFR Section 3.2.7-1, 3.2.7-2, and 3.3.5-2.

2. In the event of an exhaust radiation level that exceeds threshold level limits, operators shall be notified via an audible and visual alarm.

   Basis: Best management practice. To mitigate an excessive release, operations must be promptly notified of the release conditions. TFR Sections 3.2.7-1, 3.2.7-2, and 3.3.5-2.

3. In the event of an exhaust radiation level that exceeds high level limits, support personnel outside the WES shall be automatically notified.

   Basis: To allow support personnel to take appropriate administrative actions. TFR Sections 3.2.7-1, 3.2.7-2, and 3.3.5-2.

3.3.3 Safety-Significant Items

The CAS shall be a safety-significant system; however, since all personnel will leave the WES during a utility power outage or seismic event, the CAS is not required to function during such power outages or seismic events.

3.3.4 Applicable Regulatory and Contractual Requirements

In addition to the regulatory and contractual requirements applicable to general instrumentation and control systems, the following are specific to radiological control and emissions monitoring and criticality alarms systems:

- 10 CFR 835, "Occupational Radiation Protection" (2002)
- 40 CFR 61, Subpart H, "National Emissions of Radionuclides other than Radon from Department of Energy Facilities" (2002).

3.3.5 Applicable Industry Codes and Standards

In addition to the industry codes and standards applicable to general instrumentation and control systems, the following are specific to radiological control and emissions monitoring and criticality alarms systems:

- ANSI/ANS-8.3-1997*, Criticality Accident Alarm System* (1997)
- ANSI N 13.1, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities* (1999)

- ANSI N 42.17B, *Performance Specifications for Health Physics Instrumentation-Occupational Airborne Radioactivity Monitoring Instruments* (1989)

- ANSI N 42.18, *Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactive Effluents* (1980).

3.4 Glovebox Fissile Monitoring and Drum Assay Systems

This section contains the design criteria for the OU 7-10 Glovebox Excavator Method glovebox fissile monitoring and final drum assay systems.

3.4.1 Operational Design Criteria

The following operational design criteria are specific to the various components of the OU 7-10 Glovebox Excavator Method glovebox fissile monitoring and final drum assay systems.

3.4.1.1 Glovebox Fissile Monitoring

This section contains the design criteria for the glovebox fissile monitoring system.

The following operational design criteria are specific to the various components of the glovebox fissile monitoring.

1. The glovebox fissile material monitor system shall ensure drum loadings below 200 g fissile material by passive gamma assay of specimens.

   Basis: Per the PDSA (INEEL 2002b), Section 5.5.2.3, "Normally, stored drums or drum overpacks will contain no more than 200 g (7 oz) Pu-239 fissile gram equivalent (FGE). New waste drums or drum overpacks containing materials that exceed 200-g (7-oz) Pu-239 FGE but are ≤380 g (13.4-oz) Pu-239 FGE will be repackaged to meet the 200-g (7-oz) Pu-239 FGE limit or will be isolated in storage. If any new drum or overpack contains materials above 380-g (13.4-oz) Pu-239 FGE, the drum will be isolated and a criticality safety assessment will be performed. Further handling of the container will be governed by the results of the criticality safety assessment." These limits are imposed by Section 5.3.6, "Administrative Control – Criticality Control Program," of the *Technical Safety Requirements for the Radioactive Waste Management Complex* (INEEL 2000). TFR Sections 3.2.3-1 and 3.2.3-2.

2. There shall be three identical glovebox fissile monitoring systems, one on each of three glovebox trains.

   Basis: The same function is required to support operations in each glovebox. In addition, this supports operations and maintenance by having all identical systems. TFR Sections 3.2.3-1 and 3.2.3-2.

3. A touch screen human-machine-interface shall be provided at each of the three gloveboxes. This human-machine-interface shall provide for an operator unfamiliar with spectral analysis to initiate a specimen count, and shall display the specimen fissile content in grams, and the cumulative drum total, and any appropriate system alarms.

Basis: To ensure both efficient and effective operation at each glovebox. TFR Sections 3.2.3-1 and 3.2.3-2.

4. The glovebox fissile material monitor shall be have at least a 1-year mean time between failures.

   Basis: To ensure reliability operation of the fissile material monitoring during a short campaign. Note: Critical spare parts may be used to ensure reliability. TFR Sections 3.5.3-1 and 3.5.3-2.

5. Spares of critical or long-lead items for the glovebox fissile material monitor shall be provided so that the mean time to repair is not more than 48 hours.

   Basis: To ensure reliable operation of the fissile material monitoring during a short campaign. TFR Sections 3.5.3-1 and 3.5.3-2.

6. The glovebox fissile material monitor shall be sized to read a standardized 5-gal container.

   Basis: To support the design and operation of the glovebox. TFR Section 3.2.3-1 and 3.2.3-2.

7. The glovebox fissile material monitor shall include an electronic scale that provides a specimen weight up to 50 lb directly to the computer operating the system.

   Basis: To support calculation by the fissile material monitor in determining the fissile material mass. TFR Sections 3.2.3-1 and 3.2.3-2.

8. The glovebox fissile material monitor shall prompt the operator for a visual estimate of the volume of the specimen.

   Basis: To support calculation by the fissile material monitor in determining the fissile material mass. TFR Sections 3.2.3-1 and 3.2.3-2.

9. The glovebox fissile material monitor shall be shielded to reduce background radiation to permit reliable material monitoring.

   Basis: To ensure operation and accuracy of the fissile material monitor by minimizing the effects of background radiation. TFR Sections 3.2.3-1 and 3.2.3-2.

10. The glovebox fissile material monitor shall be designed to accommodate a range of specimen densities from HEPA filter media to soil, graphite, or metal.

    Basis: To ensure the fissile material monitor will support measurement of expected suspect material. TFR Sections 3.2.3-1 and 3.2.3-2.

11. The glovebox fissile material monitor shall incorporate self-contained, electrically operated coolers for the detectors. Liquid nitrogen cooling shall not be used.

    Basis: An extensive comparison of cooling methods was performed in the Stage II design. Electrical cooling was selected then. The same reasoning still applies to the current OU 7-10 Glovebox Excavation Method Project. A liquid nitrogen reservoir would have to be routinely filled by operators. TFR Sections 3.2.3-1 and 3.2.3-2.

12. The glovebox fissile material monitor shall have mounts that provide electrical and vibration isolation.

    Basis: To avoid damage to the sensitive detectors and help ensure accuracy. TFR Sections 3.2.3-1 and 3.2.3-2.

13. The glovebox fissile material monitor shall not be grounded to the glovebox.

    Basis: To prevent ground loops that may damage or corrupt the fissile material monitors. TFR Sections 3.2.3-1 and 3.2.3-2.

14. A central computer shall be provided to store data from all three glovebox fissile material monitors.

    Basis: TFR Sections 3.2.3-1 and 3.2.3-2.

15. Both monitor and assay systems shall be sensitive and selective enough to meet their detection limits in the maximum allowable general radiation field (1 g +/- 50%).

    Basis: To obtain necessary measurements in field conditions. TFR Sections 3.2.3-1 and 3.2.3-2.

3.4.1.2 Final Drum Assay

The following operational design criteria are specific to the final drum assay system:

1. The drum assay system shall consist of a self-contained trailer requiring only electrical utility power.

    Basis: To most effectively support the project on the basis of operations and cost. The design must use existing utilities, where available. The intent of using existing utilities is to be cost-effective by minimizing new construction, recognizing that additional utility services may be required if the processes or equipment are used for follow-on implementation at a later date. TFR Section 3.1.3-3.

2. Electrical power shall be provided to the drum assay trailer at 480 VAC, 3 phase.

    Basis: To utilize a readily available electrical power source. The design must use existing utilities, where available. The intent of using existing utilities is to be cost-effective by minimizing new construction, recognizing that additional utility services may be required if the processes or equipment are used for follow-on implementation at a later date. TFR Section 3.1.3-3.

3. The final drum assay system shall accommodate 55- and 85-gal drums.

    Basis: Standard waste containers include 55- and 85-gal drums. Safe and cost-effective storage and transport of hazardous materials require packaging in standard waste containers. TFR Section 3.1.2.4-1.

4. Drums shall be delivered to and removed from the final drum assay system by forklift.

    Basis: To accommodate drum transportation methods. TFR Section 3.1.2.2-2.

5. The final drum assay system shall be located and positioned to accommodate the process flow of drums.

   Basis: To support effective and efficient transportation methods. TFR Section 3.1.2.2-2.

6. The final drum assay system area surface preparation shall accommodate the transfer of drums.

   Basis: To ensure the satisfactory operations of the final drum assay system.

7. The final drum assay system shall be capable of identification and qualification of the following radionuclides: Pu-238, Pu-239, Pu-240, Pu-241, Am-241, U-233, U-235, U-238, Cs-137, and Co-60.

   Basis: To ensure safe storage of packaged waste.

3.4.2 Accident Design Criteria

The following accident design criteria are specific to the various components of the OU 7-10 Glovebox Excavator Method glovebox fissile monitoring and final drum assay systems.

3.4.2.1 Glovebox Fissile Monitoring

The following accident design criteria are specific to the various components of the OU 7-10 Glovebox Excavator glovebox fissile monitoring system.

1. In the event of a power failure, the fissile material monitor shall retain the valid running total for the drum currently being filled, and records for previous drums, on the restoration of power.

   Basis: To ensure orderly accurate restart of process operations. TFR Sections 3.2.3-1 and 3.2.3-2.

2. The fissile material monitoring system shall monitor the radiation level provided by background and other isotopes in the specimen. An alarm shall be provided if this level is too high to permit an accurate fissile material reading.

   Basis: To prevent erroneous readings by the fissile material monitor and damage to the detectors. TFR Sections 3.2.3-1 and 3.2.3-2.

3.4.2.2 Final Drum Assay

The following accident design criteria are specific to the final drum assay system:

1. The final drum assay system shall be supported to operate in design basis environmental conditions.

   Basis: To ensure operation of the system during possible climatic conditions (i.e., wind or snow loads)

3.4.3 Safety-Significant Items

No safety-significant items have been identified relative to the glovebox fissile material monitor system.

3.4.4 Applicable Regulatory and Contractual Requirements

No applicable regulatory and contractual requirements have been identified relative to the glovebox fissile material monitor system.

3.4.5 Applicable Industry Codes and Standards

No applicable industry codes and standards have been identified relative to the glovebox fissile material monitor system.

3.5 Closed-Circuit Television System

This section contains the design criteria for the CCTV system.

3.5.1 Operational Design Criteria

The following operational design criteria are specific to the video systems:

1. A CCTV system shall provide the excavator with adequate vision of the dig area to ensure safe effective retrieval.

   Basis: In agreement with the ALARA requirements imposed by DOE Order 420.1, "Facility Safety," and the *INEEL Radiological Controls Manual* (Radiation Protection 2000), all excavation operations for the project must be performed remotely. The CCTV system assists in remote excavation by providing cameras to view the excavation area. Performance without requiring personnel access to the excavation pit or entry into the confinement during system operation is preferred based on reducing the risk of chemical and radioactive exposure and to reduce the potential for physical injury to workers. TFR Section 3.2.2-1, 3.2.2-2, and 3.2.6-1.

2. The CCTV system shall use color video cameras and monitors.

   Basis: Color video cameras and monitors are necessary to support remote excavation and retrieval of waste within the pit. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

3. The CCTV cameras shall be equipped with pan, tilt, and zoom actuators.

   Basis: Pan, tilt, and zoom actuators are necessary to allow the operators to focus on the current excavation area to support remote operations. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

4. The pan, tilt, and zoom actuator and controls shall provide sufficient movement of the camera to sweep the entire field of the excavation pit laterally and vertically.

   Basis: Pan, tilt, and zoom actuators are necessary to allow the operators to focus on the current excavation area to support remote operations. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

5. The cameras shall be installed on the exterior wall or above the ceiling structure of the RCS and positioned to peer through transparent panels into the RCS excavation pit.

   Basis: To facilitate maintenance and D&D&D. Placement of equipment outside of the RCS supports ALARA goals. TFR Section 3.2.2-1, 3.2.2-2, and 3.2.6-1.

6. The elevation and location of the transparent panels shall be of adequate elevation and lateral positioning on the RCS wall to allow optimum view angles into the retrieval pit

   Basis: To support remote excavation and retrieval of waste contained in the pit. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

7. The video control station at the excavator shall be the primary control point for the selection and adjustment of camera parameters and there shall be one alternate control point located at the video equipment rack for camera selection and adjustment for video recording purposes.

   Basis: To support remote excavation and retrieval of waste contained in the pit. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

8. The design shall include the capability for the excavator operator to select the camera for viewing to aid in the excavation process. Provision shall be made in the design for the capability to record the video from the camera that has been selected. A video recorder also shall be included in the design to make videocassette backups.

   Basis: To support the requirement to make video data cassettes of the excavation process. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

9. The camera pan, tilt, and zoom controller located at the excavator control console shall be of adequate size and configuration to permit access to the operator without interfering with the excavator hydraulic controls.

   Basis: To support remote excavation and retrieval of waste contained in the pit. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

10. The excavator CCTV system monitor shall be sized and mounted to give the operator adequately detailed images of all digging areas.

    Basis: To support remote excavation and retrieval of waste contained in the pit. In addition, supports safe work behavior and ergonomics. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

11. A location shall be provided in the WES for a video rack of equipment consisting of remote camera control units, video recorders, video monitors, status monitors, DC power supplies, and multiplexing switches.

    Basis: To permit support personnel viewing and control functions access of system components. TFR Sections 3.2.2-1, 3.2.2-2, and 3.2.6-1.

12. The CCTV control and signal cables shall be installed in cable trays that will be mounted on the exterior of the RCS wall and ceiling structures.

    Basis: To support necessary conductors of the video system.

13. The CCTV system shall provide video recording of the sorting process at each glovebox.

    Basis: The DOE and OU 7-10 Glovebox Excavator Method Project management agreed to use cameras located above the glovebox trays to record the excavated material in order to permit a classification screening in the event that classified material were to be excavated from the pit. TFR Section 3.5.1-2.

14. The CCTV system shall provide color video cameras at each glovebox positioned to monitor the sorting process at the cart within the glovebox.

    Basis: The optical requirements contained in PLN-632, "Operable Unit (OU) 7-10 Staged Interim Action Project Physical Security Plan," Section 6.5.6 apply. The DOE and OU 7-10 Glovebox Excavator Method Project management agreed to use cameras located above the glovebox trays to record the excavated material in order to permit a classification screening in the event that classified material were to be excavated from the pit. TFR Section 3.5.1-2.

15. Color-video monitors shall be provided to monitor the operational status of the cameras and video tape recorders.

    Basis: The monitors are necessary to verify that the cameras and the video tape recorders are functioning correctly. The DOE and OU 7-10 Glovebox Excavator Method Project management agreed to use cameras located above the glovebox trays to record the excavated material in order to permit a classification screening in the event that classified material were to be excavated from the pit. TFR Section 3.5.1-2.

16. The CCTV system shall provide a means to insert a time and date stamp on the videocassette recordings.

    Basis: The time and date stamp will allow operations to link the videocassette with its associated drum. If the INEEL Classification Office identifies a classified object on the videocassettes, the specific drum containing the classified material must be retrievable from storage. TFR Sections 3.5.1-2 and 3.5.1-4.

3.5.2 Accident Design Criteria

No additional criteria are necessary for abnormal conditions

3.5.3 Safety-Significant Items

No safety-significant items have been identified for the instrumentation and control system.

3.5.4 Applicable Regulatory and Contractual Requirements

No specific applicable regulatory and contractual requirements other than those documented in Section 3.1.4 have been identified for the CCTV system.

3.5.5 Applicable Industry Codes and Standards

NEMA 250, *Enclosures for Electrical Equipment* (1997).

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Appendix A

Critical Attributes List

Appendix A

Critical Attributes List

Table A-1. Development of quality assurance requirements for the criticality alarm system.

System, Structure, or Component	Safety Function	Technical and Functional Requirements	Critical Characteristic	Supporting Technical and Functional Requirement	Specification	Method of Verification
CAS	Notify personnel in and around the WES of a criticality accident	Section 3.2.4.4. The project shall provide a CAS.	Detection of criticality accident	Same as general	Detect the minimum accident of concern See ANSI/ANS-8.3-1997, *Criticality Alarm System*	Analysis of postulated criticality accident. Calibration and testing of CAS.
			Notify personnel of criticality accident in order to quickly evacuate from predetermined area.		Notify personnel within area where they may receive any dose corresponding to an absorbed dose from neutrons and gamma rays equal to or greater than 0.12 Gy (12 rad) in free air See ANSI/ANS-8.3-1997	Testing of audible and visual alarms.

ANSI = American National Standards Institute
ANS = American Nuclear Society
CAS = criticality alarm system
WES = Weather Enclosure Structure

Table A-2. Criticality alarm system component information.

Criticality Alarm System Component	Safety Function	Applicable Performance Criteria	Critical Characteristics	Supporting Documents	Method of Verification
Detector cluster	Detect criticality	PC-2 earthquake criteria for mounting of the cluster	Sensitive to neutrons	Vendor data	Vendor data
Control module	Process signals and output alarms	PC-2 earthquake criteria for mounting of the module	Processing detector signals	Vendor data	Testing
Audible and sisual alarms	Notify personnel of accident	PC-2 Wind and earthquake loading	Maintain operation and mounting during design basis winds	Design analysis and vendor data	Analysis
Conductors, conduit, raceways	Support operation of system	PC-1 criteria for mounting of the conduit/raceways	Carry power and signals of CAS	NA	Mounted per design and codes

CAS = criticality alarm system
NA = not applicable
PC = performance criteria

Table A-3. Development of quality assurance requirements for the Glovebox Fissile Material Monitoring System sample bucket.

System, Structure, or Component	Safety Function	Technical and Functional Requirements	Critical Characteristic	Supporting Technical and Functional Requirement	Specification	Method of Verification
Sample bucket	Limit volume of free liquid in sample bucket	Section 3.2.3-1. The project shall ensure that the probability of a criticality is less than extremely unlikely.	Limit volume of free liquid in sample bucket	Same as general	Physical characteristics to limit the volume of free liquid that the sample bucket is capable of containing	Analysis of postulated criticality accident